**WHAT IS CLAIMED IS:**

1. A power supply comprising:

a buck regulator coupled to a regulator input voltage and generating a regulated output voltage for powering a load referenced to a first ground potential in response to an ON-time voltage pulse, wherein said ON-time voltage pulse has a first logic state when said regulated output voltage supplies energy to said load directly from said regulator input and a second logic state when said regulated output voltage is supplying energy stored from said regulator input voltage;

a controller for generating said ON-time voltage pulse in response to said regulator input voltage, said regulated output voltage, and a compensated reference voltage;

a reference circuit having an reference output generating a modified reference voltage relative to said first ground potential in response to a reference input voltage generated relative to a second ground potential; and

compensated reference circuitry for generating said compensated reference voltage as a time integral of a difference between said modified reference voltage and said regulator output voltage multiplied times a gain factor.

2. The power supply of claim 1, wherein said first and second ground potentials are equal potentials.

3. The power supply of claim 2, wherein a pulse width of said ON-time voltage pulse is generated in response to comparing said compensated reference to said regulated output voltage.

4. The power supply of claim 2, wherein said difference between said modified reference voltage and said regulator output voltage multiplied times said gain factor is limited to a value between a maximum positive value and a maximum negative value.

5. The power supply of claim 2, wherein said compensated reference circuitry comprises a reference amplifier having an input coupled to said reference input voltage and an amplifier output coupled to said reference output, said amplifier output generating said reference input voltage multiplied by said gain factor.

6. The power supply of claim 2, wherein said compensated reference circuitry comprises:

a reference amplifier having an input coupled to said reference input voltage and an amplifier output generating said reference input voltage multiplied by said gain factor; and

a digital to analog converter (DAC) having a DAC reference input coupled to said amplifier output, a plurality of digital input signals, and a DAC output coupled to said reference output.

7. The power supply of claim 1, wherein a pulse width of said ON-time voltage pulse is generated in response to comparing said compensated reference to said regulated output voltage.

8. The power supply of claim 1, wherein said difference between said modified reference voltage and said regulator output voltage multiplied times said gain factor is limited to a value between a maximum positive value and a maximum negative value.

9. The power supply of claim 1, wherein said compensated reference circuitry comprises:

a reference amplifier having an input coupled to said reference input voltage and an amplifier output coupled to said reference output, said amplifier output generating said reference input voltage multiplied by said gain factor;

a voltage to current converter having an input coupled to said amplifier output and a current output generating a current proportional to said reference input voltage multiplied by said gain factor; and

a resistor having a first terminal coupled to said first ground potential and a second terminal coupled to said current output and said reference output, wherein said modified reference is generated relative to said first ground potential.

10. The power supply of claim 9, further comprising a capacitor coupled across said resistor.

11. The power supply of claim 1, wherein said compensated reference circuitry comprises:

a reference amplifier having an input coupled to said reference input voltage and an amplifier output, said amplifier output generating said reference input voltage multiplied by said gain factor;

a digital to analog converter (DAC) having a DAC reference input coupled to said amplifier output, a plurality of digital input signals, and a DAC output generating a DAC voltage proportional to said reference input voltage multiplied by said gain factor in response to logic states of said digital input signals;

a voltage to current converter having an input coupled to said DAC output and a current output generating a current proportional to said DAC voltage; and

a resistor having a first terminal coupled to said first ground potential and a second terminal coupled to said current output and said reference output, wherein said modified reference is generated relative to said first ground potential.

12. The power supply of claim 11, further comprising a capacitor coupled across said resistor.

13. The power supply of claim 1, wherein said compensated reference circuitry comprises;

transconductance amplifier having a gain Gm, a positive input coupled to said modified reference voltage, a negative input coupled to said regulator output voltage, and slew current output generating a slew current proportional to a difference between said modified reference voltage and said regulator output voltage times said gain Gm; and

a capacitor having a capacitance Cm, a first terminal coupled to said second ground potential and a second terminal coupled to said slew current output, wherein a voltage across said capacitor generates said compensated reference voltage and said gain factor is said gain Gm times said capacitance Cm.

14. A system comprising:

a processor referenced to a first ground potential;

a memory for storing instructions and data for said processor;

a power supply having a buck regulator coupled to a regulator input voltage and generating a regulated output voltage coupled to said processor in response to an ON-time voltage pulse wherein said ON-time voltage pulse has a first logic state when said regulated output voltage supplies energy to said processor directly from said regulator input and a second logic state when said regulated output voltage is supplying energy stored from said regulator input voltage;

a controller for generating said ON-time voltage pulse in response to said regulator input voltage, said regulated output voltage, and a compensated reference voltage;

a reference circuit having an reference output generating a modified reference voltage relative to said first ground potential in response to a reference input voltage generated relative to a second ground potential; and

compensated reference circuitry for generating said compensated reference voltage as a time integral of a difference between said modified reference voltage and said regulator output voltage multiplied times a gain factor.

15. The system of claim 14, wherein said first and second ground potentials are equal potentials.

16. The system of claim 15, wherein a pulse width of said ON-time voltage pulse is generated in response to comparing said compensated reference to said regulated output voltage.

17. The system of claim 15, wherein said difference between said modified reference voltage and said regulator output voltage multiplied times said gain factor is limited to a value between a maximum positive value and a maximum negative value.

18. The system of claim 15, wherein said compensated reference circuitry comprises a reference amplifier having an input coupled to said reference input voltage and an amplifier output coupled to said reference output, said amplifier output generating said reference input voltage multiplied by said gain factor.

19. The system of claim 15, wherein said compensated reference circuitry comprises:

a reference amplifier having an input coupled to said reference input voltage and an amplifier output generating said reference input voltage multiplied by said gain factor; and

a digital to analog converter (DAC) having a DAC reference input coupled to said amplifier output, a plurality of digital input signals, and a DAC output coupled to said reference output.

20. The system of claim 14, wherein a pulse width of said ON-time voltage pulse is generated in response to comparing said compensated reference to said regulated output voltage.

21. The system of claim 14, wherein said difference between said modified reference voltage and said regulator output voltage multiplied times said gain factor is limited to a value between a maximum positive value and a maximum negative value.

22. The system of claim 14, wherein said compensated reference circuitry comprises:

a reference amplifier having an input coupled to said reference input voltage and an amplifier output coupled to said reference output, said amplifier output generating said reference input voltage multiplied by said gain factor;

a voltage to current converter having an input coupled to said amplifier output and a current output generating a current proportional to said reference input voltage multiplied by said gain factor; and

a resistor having a first terminal coupled to said first ground potential and a second terminal coupled to said current output and said reference output, wherein said modified reference is generated relative to said first ground potential.

23. The system of claim 22, further comprising a capacitor coupled across said resistor.

24. The system of claim 14, wherein said compensated reference circuitry comprises:

a reference amplifier having an input coupled to said reference input voltage and an amplifier output, said amplifier output generating said reference input voltage multiplied by said gain factor;

a digital to analog converter (DAC) having a DAC reference input coupled to said amplifier output, a plurality of digital input signals, and a DAC output generating a DAC voltage proportional to said reference input voltage multiplied by said gain factor in response to logic states of said digital input signals;

a voltage to current converter having an input coupled to said DAC output and a current output generating a current proportional to said DAC voltage; and

a resistor having a first terminal coupled to said first ground potential and a second terminal coupled to said current output and said reference output, wherein said modified reference is generated relative to said first ground potential.

25. The system of claim 24, further comprising a capacitor coupled across said resistor.

26. The system of claim 14, wherein said compensated reference circuitry comprises;

transconductance amplifier having a gain Gm, a positive input coupled to said modified reference voltage, a negative input coupled to said regulator output voltage, and slew current output generating a slew current proportional to a difference between said modified reference voltage and said regulator output voltage times said gain Gm; and

a capacitor having a capacitance Cm, a first terminal coupled to said second ground potential and a second terminal coupled to said slew current output, wherein a voltage across said capacitor generates said compensated reference voltage and said gain factor is said gain Gm times said capacitance Cm.